PROBLEMS OF EPIDEMIOLOGICAL GEOGRAPHY III. GLOBAL NOSOLOGICAL AREAS

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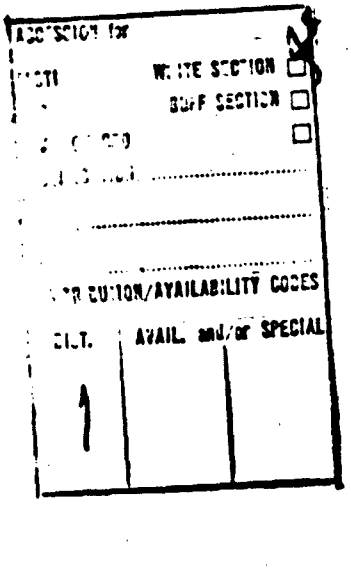

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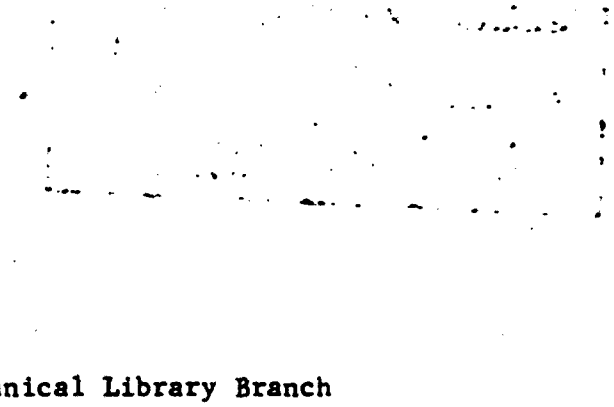

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PROBLEMS OF EPIDEMIOLOGICAL GEOGRAPHY III. GLOBAL NOSOLOGICAL AREAS

[Following is the translation of an article by I. I. Yelkin and V. K. Yashkul, 1st Moscow Medical Institute of the order of Lenin imeni I. M. Sechenova, published in the Russian-language periodical Zhurnal Mikrobiologii Epidemiologii i Immunobiologii (Journal of Microbiology, Epidemiology and Immunobiology), #1, 1965, pages 91--96. The article was submitted to the editors on 24 April 1964. Translation performed by Sp/4 Richard M. Koplen.]

A large number of modern infectious and invasive diseases of man are characterized by the fact that mankind, up to now, still hasn't found effective means for combating them. Due to this, the active antiepidemic activities of man are not able to show a noticeable influence on their distribution. The nosological areas of these infections and invasions, based on extent, essentially can be distinguished from each other. Thus, in some cases infectious and invasive diseases of man can be distributed universally (have global nosological areas). Endemic or enzootic foci of these diseases are found, with rare exceptions, where man lives. Another group of nosological areas is characteristic for those diseases which are distributed on more limited territories. These nosological areas, in their turn, can be divided into zonal and regional.

Together with this, among modern infections and invasions there are some nosological forms against which man has found effective measures of prevention. The problem of liquidation of these diseases is already solved and the possibility of such liquidation actually proven. However, in many countries these infections and invasions are still endemic on the strength of historical and social causes. Nosological areas of this group we classify as residual.

Thus, modern infectious and invasive diseases of man possess global, zonal, regional and residual nosological areas (see table).

During an examination of the problem of epidemiological geography, we made attempts at the analysis of formation processes of various types of nosological areas. In the present report we will dwell on global nosological areas.

Infections and invasions having global nosological areas are endemic for the majority of continents of the globe (ubiquitous diseases or cosmopolitan diseases), although on individual territories at a certain time they may not be found.

A large number of universally distributed infectious and invasive diseases of man are anthroponoses, which is explained by a number of reasons. Evidently, the main factor of giobal distribution of diseases of man is the universal distribution of

man himself. However, the conditionality of geography of anthroponoses with a great number of historical, biological and social factors is explained by the fact that global nosological areas are possessed only by those diseases of that group, to which the specific qualities are fully characteristic. Thus, the causative agents of anthroponoses having global distribution passed the route of phylogenetic adaptation to man in the majority of cases in relatively late historical periods, when the major features of modern society, in an epidemiological relation, already were formed (relatively high density of population, intensive migration of people, high degree of contact). Owing to this, the causative agent of anthroponoses proved to be well adapted to existence in modern human society, and the endemic foci of these diseases at present are preserved very persistently. No less an important factor promoting the wide distribution of these diseases is the weak dependency of their epidemic processes on conditions of the geographical surrounding. Namely therefore, universally distributed anthroponoses are primarily a group of infections with an air-droplet mechanism of transmission, which to the least degree depends on the condition of the geographical environment and for the realization of which does not require other factors of transmission. These infections, in one form or another, are conveyed to practically all populations of the world (measles, whooping cough, influenza and some others). In addition to that, the incidence with many anthroponoses possessing global distribution has considerably lower indices. These diseases strike only part of the population of the earth owing to the fact that their distribution is connected with various factors of transmission and the level of morbidity is often influenced by peculiarities of the geographical environment (typhoid fever, paratyphoid, bacterial dysentery and others).

Primary nosological areas (centers of formation) of anthroponoses which are cosmopolitan, of course occupied relatively small territories. The distribution of many of these in the old days was confined here and there to the places of formation of ancient human cultures, where they often occurred. However, already in that time, as a result of the migration of man on the face of the earth and the broadening of economic relations between countries, many anthroponoses exceeded the bounds of the "centers of formation". In addition to that, the overwhelming majority of thousand year anthroponoses retained quite definite nosological areas (principally within Eurasia and Africa) and only individual nosological forms which had acquired global distribution migrated along the path of primary settling of man (for example, syphilis). This is accounted for in the first place by the fact that the primary settling of man took place at a time when many anthroponoses were in the formation stage or still had not emerged. Furthermore, the relatively low density of the population and the nomadic form of life of primitive people were insurmountable epidemiological barriers for the migration with them of many of these anthroponoses which had already emerged in this period.

Subsequently, two main factors played an enormous role in the spreading of anthroponoses: The settling of Europe and the intensification of

commercial-industrial and military operations. Namely these factors, which acquired meaning in the spreading of diseases only in the period of the development of capitalism, led to the sudden broadening of nosological areas and the emergence of a large number of global anthroponoses.

A characteristic example of such a path of formation and distribution of diseases can be measles. The virus of measles, based on antigenic structure, is close to the virus of dog plague from which, evidently, it also originated. The time of origin of measles and its "center of formation" now are difficult to establish. However, the features of epidemiology of this infection indicate that in contemporary form it may have appeared relatively late, when on the land there emerged vast territories with a high density of population and intensive contact among the people. It is highly probable that such territories were regions of tropical and sub-tropical Asia (China, India), where a high density of population over huge expanses arose comparitively earlier. However, only in the 6th century of our era did Ibn-Sina for the first time begin to differentiate measles from small pox (Vogralik, 1935). In Europe also measles began to be diagnosed only in the 16th century. At that time it was a children's infection. In the New World measles did not become known until the open- of this continent by Europeans. So, measles acquired global distribution only a few centuries ago.

Global nosological areas have also a significant number of zoonoses. The bulk of them are regarded as infections and invasions of farm animals. There is no doubt that in the distant past these zoonoses, as a rule, did not have such a wide distribution as they have in our time. Global nosological areas for them appeared only in comparatively recent historical periods, which was connected with the economic activities of man.

Thus, brucellosis at the end of the tertiary and at the beginning of the quaternary period, evidently was an infection of wild artiodactyls, from whom it was transmitted to domesticated animals (primarily to representatives of the sheep-goat group and possibly also to cattle and pigs). On account of this, brucellosis of domestic animals in the period of their domestication should be limited only to areas where the process of domestication of artiodactyls occurs, that is to territories of South Eurasia and Northern Africa (Bogolyubskiy, 1959). Later, wild artiodactyls were destroyed on the greater part of their areas and for all practicle purposes the brucellosis infection turned out to be a disease of farm animals, with which it was spread also to all the continents of the earth (fig. 1). Apparently, glanders also was distributed primarily in Eurasia as an initial infection of representatives of the Genus Equus in the period of domestication of horses (and probably also reindeer) among domesticated animals. Due to the disappearance of wild parents on this territory, the infection turned out to be a disease of farm animals by which in considerably recent time it was delivered to all corners of the world.

Another group of zoonoses having global distribution was infections of synanthropic animals--murine rickettsiosis, ratbite fever, hymenolepiasis,

dipylidiasis. The distribution of these infections and invasions in the pre-historic period was also limited, and their global nosological areas were formed in connection with the practical activities of man in relatively late periods.

Thus, there are bases to assume that murine rickettsiosis is a primary infection of wild rats. This is testified to by the fact that in an experiment, rats are readily infected with rickettsioses of endemic typhus and the causative agents are preserved in their organism for a long time (Maxi, 1949, and others), and by the fact that wild rats are affected by endemic typhus in natural conditions (Musser with coauthors, 1931). Therefore, the primary areals of murine rickettsiosis should be considered as South-East Asia, Indonesia and the adjacent islands of Java and Sumatra (fig. 2). Namely, on these territories at present, there are preserved wild representatives of the genus Rattus and, in particular, R. rattus rogeri Sody, which are, in the opinion of many investigators, the ancestors of modern synanthropic animals---black rats (R. rattus) and gray rats or Norway rats (R. norvegicus).

Wild rats are a relatively young group of rodents. They were formed, probably, only at the end of the tertiary period. However, they became synanthropic relatively early, in connection with which already in the ancient time of human history, they migrated by land to the countries of South Eurasia. It is assumed that the native land of R. rattus was India. But also, such foci of initial human culture, as Asia Minor, the Mediterranean and China, were populated with black rats very long ago. From Mediterranean countries in later periods of time, the black rate, in relatively small numbers, infiltrated into Western and Central Europe and the Caucasus, and also to the Malay archipelago, Australia and other countries of the world. In America the black rat was brought in during the time when navigation was developing. In this period it began to compete with the Norway rat, therefore it populated mainly coastal territories and hardly penetrated the depth of the continent.

The gray rat was settled primarily in India, from where in relatively recent time it infiltrated Europe by sea. In the first half of the 18th century it was still rarely encountered here, but an intensive settlement of it had already begun: In 1775 the Norway rat was brought in to America, where it was quickly distributed; at the verge of the 18th--19th centuries the Norway rat had penetrated Eastern Europe and toward the middle of the 19th century it became common on the Volga; at the end of the 19th century it reached the Urals and at the beginning of the 20th century it became settled in Siberia by means of the railroad.

R. norvegicus sogaso---a native of East Asia---long ago populated the territory of East Siberia and China. It also was inclined to migrate along the railroad route and dispersed by means of the Transsiberian railroad toward the Norway rat, reaching the Trnsbaikal region.

The process of settlement of rats created prerequisites also for the broadening of the areal of causative agent of murine rickettsiosis with the

forming on all continents of the world of enzootic (synanthropic) foci of this infection.

At present the black rat is spread primarily in the southern hemisphere, but also occupies the zone of the tropical belt. The gray rat is distributed primarily in the northern hemisphere. On the whole, synanthropic rats populated all the continents of the world and did not penetrate only those areas which were little populated by man. In the majority of points where synanthropic rats are common, murine rickettsiosis is also encountered. It is highly probable that ratbite fever also is spread by analogous paths.

Some naturally focal zoonoses have global nosololigal areas---rabies, echinococcosis, trichinosis. There are bases to suppose that also in this case the practical activity of man exerted an appreciable influence on the current distribution of natural foci of these diseases. Thus, many of these diseases are widely distributed not only among wild, but also among domesticated animals with whom their causative agents can migrate to new continents. Really, rabies at present is not detected only in Australia. However, in countries of the New World this infection evidently was brought in with dogs, where it also took root in secondary foci. It is very probably also that echinococcosis with various farm animals also was brought in to various corners of the world where it was not earlier encountered. Only trichinosis, evidently, had global distribution initially, although the possibility is not eliminated that with domestic pigs and synanthropic rats it was brought in to Australia by man.

In the group of anthropozoonoses, hymenolepiasis and taeniases have global nosological areas. Along with this, the distribution of hymenlepiasis in all appearance, was connected with the migration of man himself, and taeniases obtained universal distribution undoubtedly in connection with the spreading over the world of various species of cattle and pigs.

Thus, the basic factors which determine the global distribution of a considerable number of modern infectious and invasive diseases were man himself and his practical activity. In a definite stage of development of human society conditions emerged which were favorable for the sharp broadening of nosological areas, which is primarily connected with intensive economic activity, a high degree of intra- and intercontinental contact between people and the actual absence of combating infections and invasions for the full length of the centuries.

Literature

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Types of nosological areals of the most important infectious and invasive diseases of man.

	Global	Zonal	Regional	Residual
Anthroponoses	Typhoid Paratyphoid A&B Bacterial dysentery Botkin's disease Poliomyelitis Enterobiosis Diphtheria Scarlet fever Whooping cough Measles Chickenpox, varicella Epidemic meningitis Viral influenza Epidemic parotitis Tuberculosis Syphilis	Pinta disease Frambesia Ascariasis Trichocephaliasis Necatoriasis Wuchereriasis (W. bancrofti)	Cholera Kala-azar Acanthocheilonemiasis Loiasis Onchocerciasis	Smallpox Malaria Pediculous exanthematous fever Pediculous recurrent typhus Trachoma Late-ulcerating leishmaniasis
Zoonoses	Brucellosis Leptospirosis Glanders Listerellosis Balantidiasis Q rickettsiosis Sodoku Murine typhus Hymenolepiasis murina Dipylidiasis Rabies Trichinosis Echinococcosis	Plague Tularemia	Tick-borne encephalitis Mosquitoe encephalitis Yellow fever Tick-borne recurrent typhus Hemorrhagic fever Paroxysmal rickettsiosis Tick-borne rickettsiosis Acute necrotic leishmaniasis Espundia Clonorchiasis Schistosomiasis japonica	

Types of nosological areals of the most important infectious and invasive diseases of man. (continued)

	Global	Zonal	Regional	Residual
Anthropzoonoses	Hymenolepiasis	Amebiasis Ancylostomiasis Dengue Phlebotomus fever	African trypanosomiasis American trypanosomiasis Mediterranean trypanosomiasis South American leishmaniasis Urogenital schistosomiasis Intestinal schistosomiasis	Yellow fever Taeniasis Diphyllobothriasis Dracunculus-worm disease

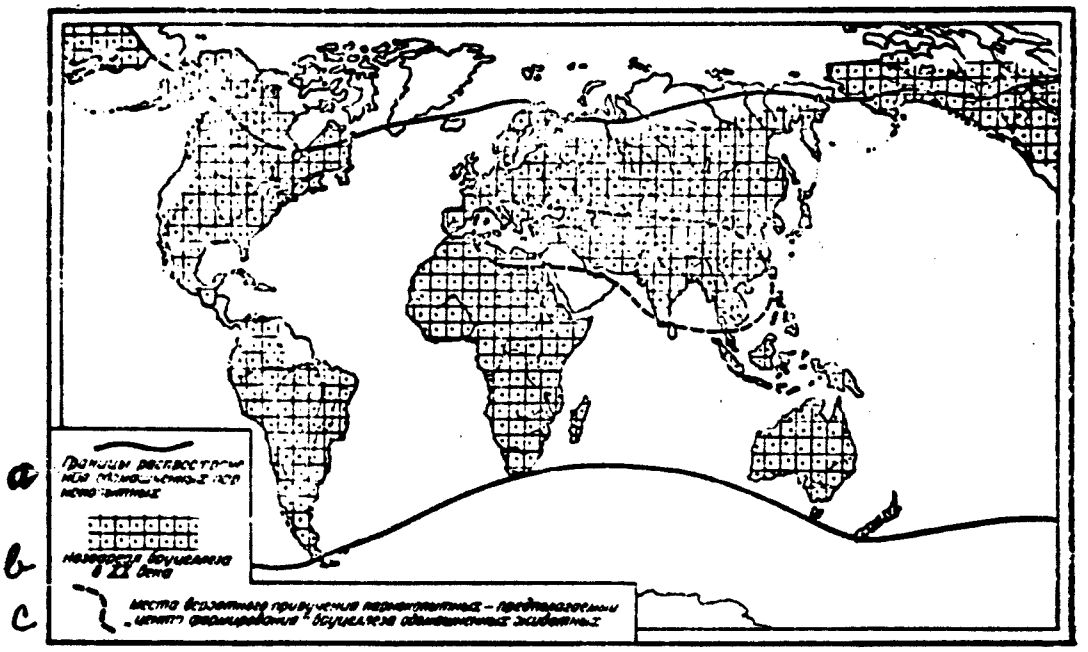

Figure 1. Distribution of brucellosis in the world.

a. Limits of distribution of domesticated Artiodactyla.

b. Nosological areal of brucellosis in the XXth century.

c. Sites of probable domestication of Artiodactyla -- probable center of f of brucellosis of domestic animals.

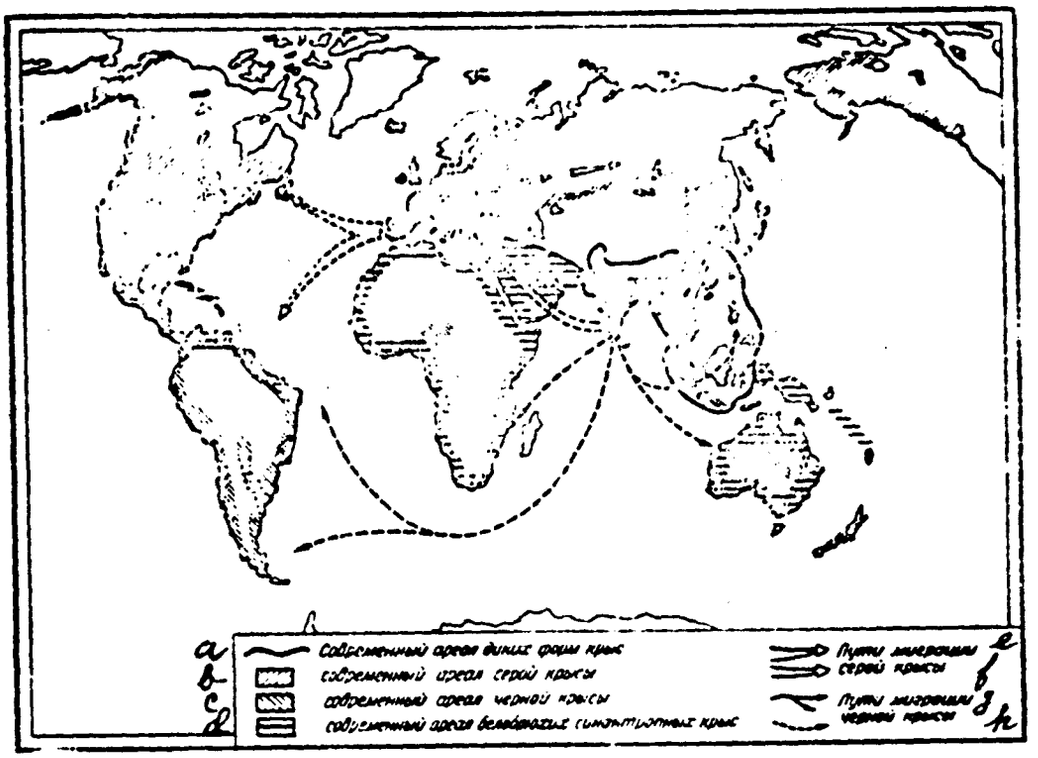

Figure 2. Settlement of synanthropic rats throughout the world and their areals.

a. Modern areal of wild forms of rats.
b. Modern areal of the gray rat.
c. Modern areal of the black rat.
d. Modern areal of monk synanthropic rats.
e. f. Paths of migration of the gray rat.
g. h. Paths of migration of the black rat.